Using Linked Program and Birth Records to Evaluate Coverage and Targeting in Tennessee's WIC Program

RAY YIP, MD, MPH
LEE FLESHOOD, PhD, MPA
THOMAS C. SPILLMAN, BA
NANCY J. BINKIN, MD, MPH
FAYE L. WONG, RD, MPH
FREDERICK L. TROWBRIDGE, MD MSC

Four of the authors are with the Division of Nutrition, Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control, Atlanta, GA. Dr. Yip is Chief, Maternal and Child Health Section, Epidemiology Branch, Dr. Binkin is Chief, Epidemiology Branch, Ms. Wong is Chief of the Field Service Branch, and Dr. Trowbridge is Director of the Division.

Dr. Fleshood is Director, Nutrition and Supplemental Food Programs, and Mr. Spellman is Chief, Data Utilization Division, both of the Tennessee Department of Health and Environment, Nashville.

Tearsheet requests to Ray Yip, MD, MPH, DN, CCDPHP, Mail Stop K26, Centers for Disease Control, Atlanta, GA 30333.

Synopsis

Public health nutrition programs are intended to serve low-income families who are at greater nutritional risk than the general population. Not all persons who are program-eligible are at equal risk, however. It would be desirable to evaluate a program's ability to enroll persons from higher risk backgrounds in the population (coverage) and, conversely, the extent to which those enrolled in this program are at higher risk (targeting).

A method for the evaluation of coverage and targeting was developed using data from the Tennessee Women, Infants, and Children Special Supplemental Food Program (WIC) linked with birth certificates. The linked computer file was created by matching the name and date of birth in both record files. The birth records were the common source of information used to characterize the risk background for both the WIC and non-WIC participants. Maternal sociodemographic information on the birth records was used to define the health risk background of each child. The coverage and targeting of "at-risk" children were computed and compared for 50 counties or county-aggregates in Tennessee.

Considerable variation in the coverage and targeting rates of at-risk children was observed among Tennessee counties, although the counties within each WIC administrative region tended to have similar coverage and targeting patterns. Using the existing data in linked program and vital records provides a direct evaluation of a program. Coverage and targeting evaluation can be used to detect underserved populations within small geographic areas.

PUBLIC HEALTH PROGRAMS in the United States are intended to serve low-income families who are at risk for poor health or poor nutrition outcomes. Because of limited resources, some programs are not able to serve all of those who meet the eligibility requirements (*1,2*). Even though low income is generally correlated with poor health outcomes, not all low-income families share the same risk. Therefore, it is important for a given program to identify and provide service to those at greatest risk within the eligible population. The ability to serve those at greatest risk can be characterized in two ways. The first is coverage, which is defined as the proportion of persons in a population who meet certain risk criteria and are enrolled in the program. The second is targeting, which is the proportion of persons enrolled in the program who meet the defined risk criteria. Proper evaluation of the coverage and targeting of a program can help in the detection of underserved populations and in more efficient allocation of resources.

To evaluate the coverage and targeting of a program, one needs to characterize the risk background of all persons within the program's catchment area as well as their individual status with regard to enrollment. However, this is difficult since programs usually have information on program participants but lack information on nonparticipants. Because of this barrier, few evaluations of coverage and targeting have taken place among public health nutrition programs. To overcome the

lack of information on nonparticipants, we developed a method of evaluation by linking the public health program's records with the vital birth records. Birth records served as the source of information on the risk status of all children in the population regardless of their program enrollment status. In this report, we demonstrate the utility of using data from the Tennessee Women, Infants, and Children Special Supplemental Food Program (WIC) linked with vital birth records to evaluate the program. It is important to point out that the proposed method of program evaluation is intended to detect potentially underserved areas. This evaluation method is not intended to establish potential criteria for actual WIC enrollment.

Material and Methods

Data sources. To evaluate the Tennessee WIC coverage and targeting rates for children born between 1982 and 1984, we linked two data sets. The first data set consisted of records from the Pediatric Nutrition Surveillance System data file at the Centers for Disease Control (CDC) (*3*) for children from Tennessee born between 1982 and 1984 and enrolled in WIC before 1986. Data were collected for all children under 5 years. The data collected include date of birth, sex, race, height, weight, and hematocrit measurements. The second data set used in our analysis was the 1982 to 1984 birth records provided by the Vital Health Statistics Center of Tennessee. These records contained birth weight and major parental sociodemographic information in addition to the child's name and date of birth.

Data linkage. For the evaluation, only the records of the first WIC visit for the 43,878 children born between 1982 and 1984 and enrolled in WIC before 1986 were used. These initial WIC visit records were then matched and merged with the Tennessee resident birth-record file for 1982 to 1984 for the 95 counties with full participation in the WIC Program (4 out of 95 counties were excluded because of joint participation in the Commodity Food Supplement Program and WIC). This 3-year birth cohort file for counties with full WIC participation contained a total of 136,622 birth records. Linkage was performed by matching the last name, first initial, and date of birth from the two record files. Overall, 89 percent or 38,990 of the WIC records were successfully linked to birth records. For 0.7 percent of the WIC records, there was more than one birth certificate match. These cases with multiple matches were eliminated from the analysis. Data from the WIC records indicated that the 11 percent of WIC children with unmatched records had similar race and birth weight distributions compared with those WIC children whose records were successfully matched.

Definition of SES based risk factors. We defined an at-risk child as having one or more of the following three maternal SES risk factors: (*a*) the mother was 17 years of age or younger at the time of the child's birth, (*b*) she had completed less than 12 years of education, and (*c*) she was unmarried. Nonrisk children were those whose mother had none of the three risk factors. The SES characteristics used for this assessment were chosen because of their demonstrated correlation with poor child health outcomes (*4,5*). To illustrate the predictive ability of these risk factors for adverse outcome, we first compared the low birth weight (LBW, birth weight less than 2,500 gm) rates between at-risk and nonrisk births for all Tennessee births from 1982 to 1984. Second, for the WIC population only, we compared the prevalence of low height-for-age (shortness, based on height-for-age below two standard deviations of the U.S. growth references) between at-risk and nonrisk children.

Comparison of WIC Program coverage and targeting among regions and counties. The coverage rate and targeting rate of at-risk children were compared for Tennessee counties. Rural counties with less than 100 births annually were aggregated with adjacent counties within the same region to increase the reliability of the computed rates. This process resulted in a total of 50 counties or county aggregates derived from the original 95 counties. Computation of the prevalence of at-risk children, the coverage rate, and the targeting rate is expressed in the following formulas:

Prevalence of "at-risk" children = Number of "at-risk children ÷ Total number of children

Coverage rate = Number of at-risk children enrolled in WIC X 100 ÷ Total number of at-risk children in the population

Targeting rate = Number of at-risk children enrolled in WIC X 100 ÷ Total number of children enrolled in WIC

The targeting rate is dependent on the prevalence of at-risk children in the area being studied: the higher the prevalence of at-risk children, the greater the likelihood that the targeting rate will be

Figure 1. Statewide average for prevalence of at risk children, WIC enrollment rate, coverage rate, and targeting rate of the Tennessee childhood WIC Program

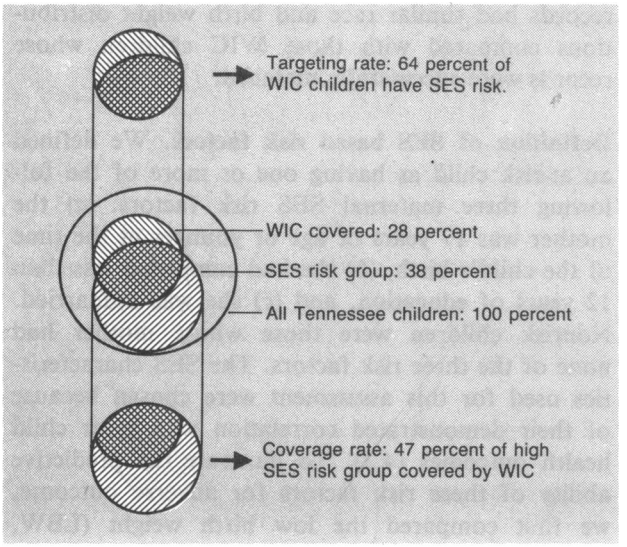
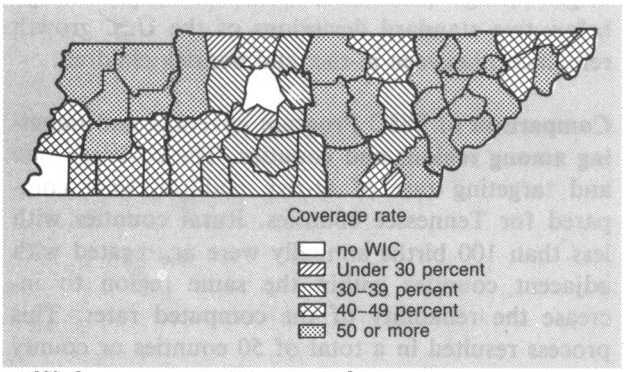
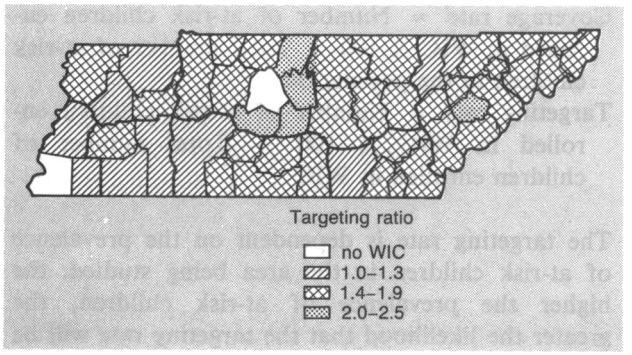


Figure 2. Comparison of WIC coverage rates for at risk children among the 50 county units



NOTE: Coverage rates vary widely across the State, but there are similarities in rates within regions, defined by the thicker border lines. Counties in white (no WIC) have mixed WIC and Commodity Food Supplemental Programs and were excluded from the analysis.

Figure 3. Comparison of the targeting ratio of Tennessee WIC Program across the 50 county units



high. As a result, an adjustment of the targeting rate was needed to account for the variation in prevalence of at-risk children and allow for a fair comparison of targeting rates among different areas. We devised an adjustment method called "relative targeting ratio" to provide for such comparison. The computation formula for this relative targeting ratio is

Relative targeting ratio = Prevalence of at-risk among WIC children ÷ Prevalence of at-risk among non-WIC children

For this study, both the coverage and targeting rates were based on the matched cases on the birth-WIC linked file without adjusting for the unmatched cases. Because 11 percent of the WIC-enrolled children did not have birth-record matches, the actual coverage and targeting rates would have been higher.

Results

Distribution and health outcome characteristics of Tennessee at-risk children. Between 1982 and 1984, 38 percent of the 135,622 Tennessee children included in the analysis were considered at risk, whereas 62 percent were considered nonrisk. During the same period, 38,990, or 28.5 percent of Tennessee children, were enrolled in the WIC Program.

To demonstrate that the SES-risk definition used in our analysis was indeed predictive of poor health outcomes, we compared the low birth weight rate for the entire Tennessee birth cohort and the rate of low height-for-age (shortness) for WIC participants between at-risk and nonrisk children (see table). We found that the at-risk children had a low birth weight rate that was 2.2 times (relative risk) that of the nonrisk children and that the shortness rate for the "at-risk" children was 3.3 times that of the nonrisk children. Both differences were statistically significant ($P < 0.001$, chi-square).

Statewide SES-risk prevalence and WIC coverage and targeting. Figure 1 is a diagram of the statewide proportion of at-risk children, the proportion of children enrolled in WIC, and how coverage and targeting rates were calculated. The statewide coverage rate of 47 percent is the proportion of all at-risk children who were enrolled in WIC. This indicates that nearly half of the children defined as "at-risk" by this study were enrolled in the WIC

Program. The statewide targeting rate of 64 percent is the proportion of all WIC enrolled children who also fulfilled the "at-risk" criteria of this study. This means that almost two out of three children on the WIC Program came from the at-risk subpopulation. The statewide targeting ratio was 2.25, as determined by dividing the targeting rate of 64 percent by the at-risk prevalence rate of 20 percent for the non-WIC children (28 percent). Thus, WIC children were 2.25 times more likely than non-WIC children to come from an at-risk background.

Variation in prevalence of at-risk children among Tennessee counties. Even though the statewide prevalence of children at risk was 38 percent, the prevalence among counties across the State ranged from 26 to 60 percent. It is this variation that makes it necessary to adopt an adjustment procedure for the evaluation of targeting practices. This pattern of variation also makes it clear that the task faced by local WIC workers in enrolling high-risk children can be very different from one location to another.

Comparison of WIC Program coverage among Tennessee counties. A comparison of the coverage rate for children "at risk" in the 50 county units is presented in figure 2. Although there were wide variations in coverage rates across the State (from 31 to 61 percent), counties within each administrative region tended to have similar coverage patterns. This suggests that some of the observed variation in coverage among local WIC Programs was related to the way programs are administered at the regional level. Coverage was lowest in rural areas, which may reflect the difficulties of providing health care in a sparsely populated area.

Comparison of WIC targeting rates and ratios among Tennessee counties. There are also significant variations in the targeting rates of the 50 county units. Similar to the pattern observed for coverage rates, significant variations were observed among regions and county units ranging from 49 percent to 78 percent. Within the same region, however, the targeting rates were more comparable.

Because targeting rates are influenced by the prevalence rates of at-risk children, and there was a great deal of variation in the prevalence of at-risk children in Tennessee, we also compared the relative targeting ratios. Again, we observed considerable variations in the relative targeting ratios among the 50 county units, with values ranging from 1.14 to 2.65 (fig. 3). In some geographic areas, the enrolled WIC children have a higher percentage from an at-risk background than those in other areas. These variations may reflect regional differences in WIC enrollment practices.

Comparison of low birth weight rate for 135,622 children born in Tennessee and low height-for-age rate for 38,990 children enrolled in Tennessee WIC in nonrisk and at-risk groups, 1982–84

Group	Low birth weight (2,500 grams or less)		Low height-for-age (−2 SD of references)	
	Prevalence (percent)	Relative risk	Prevalence (percent)	Relative risk
Nonrisk	4.1	1.00	1.2	1.00
At risk [1]	8.8	2.15	3.9	3.25

[1] At-risk child has 1 or more of 3 risk factors: mother 17 years old or younger at the birth, mother has less than 12 years of education, mother unmarried.
NOTE: nonrisk group is the referent group to determine the relative risk of low birth weight and low height for age rates.
SD = standard deviation.

Discussion

The WIC Program served more than 3,500,000 million infants, children, and pregnant and lactating women in the United States in 1989. However, it is estimated that WIC is only able to serve approximately one-third of the population that is potentially eligible for the program (*1*). Existing evidence, although not conclusive, suggests that WIC has a greater health impact among those at greatest risk (*6,7*). Because of the large pool of eligible but unserved persons and the variation in the risk background among those eligible, it is appropriate to ask: how can the WIC program target its service to higher risk subgroups of persons among all those who are eligible? One potential approach is to determine geographic areas with relatively low coverage or targeting rates.

This proposed method for assessing coverage and targeting demonstrates the feasibility of using existing data in a State for program evaluation without conducting a special survey. The use of program data linked with birth records enables the direct assessment of coverage and targeting patterns. The next closest type of coverage evaluation relies on an indirect approach to estimate the size of the at-risk population in a State. This approach is based usually on census data combined with key indices from vital birth records such as the low birth weight and teenage pregnancy rates (*1,2*). One drawback of estimates derived from such indirect approaches is the inability to determine whether the subpopulation deemed to be at high risk for poor

'The WIC Program served more than 3,500,000 infants, children, and pregnant and lactating women in the United States in 1989. However, it is estimated that WIC is only able to serve approximately one-third of the population that is potentially eligible for the Program.'

nutrition and health outcome is actually enrolled in WIC. Also, an indirect approach may not offer enough precision in determining the size of the at-risk population in small geographic areas (*8*).

There are four possible outcomes in the evaluation of coverage and targeting in multiple areas. Ranked according to decreasing desirability, they are (*a*) high coverage and high targeting, (*b*) high coverage and low targeting, (*c*) low coverage and high targeting, and (*d*) low coverage and low targeting. The merit of the first combination and the problem of the last combination are self-evident. The second combination, high coverage and low targeting, can best be described as an area where most at-risk persons are covered, and many nonrisk persons are also covered. This situation can be viewed as a case of over coverage. The third combination of low coverage and high targeting can best be described as an area with inadequate resources to cover all eligible persons, but those covered are at risk.

This example, the Tennessee WIC Program, suggests that there are geographic areas where the relative targeting ratio is relatively low and that there is room for improvement (fig. 3). Additional evidence of less-than-ideal WIC targeting comes from the survey on WIC targeting reported by the General Accounting Office and Missouri's prenatal WIC outcome evaluation using linked data (*1,9,10*). The authors of the Missouri study found that a large proportion of children enrolled in the Medicaid Program were not enrolled in WIC, even though Medicaid had stricter income criteria (60 percent of poverty level) than WIC (185 percent of poverty level) (*9,10*).

It is important to point out that the SES-based risk criteria used in this evaluation are not the same as the income- and nutrition-based criteria used to determine eligibility for the WIC Program. The at-risk criteria are intended for uniform evaluation of coverage and targeting patterns. Not all children with an SES risk status are income-eligible for WIC, and not all who are income-eligible are at SES risk. Other potential at-risk indices can be used for coverage and targeting evaluation, such as the rates of low birth weight and infant mortality which are also available through linkage with vital records.

Despite the fact that the SES risk does not necessarily identify the same children, an argument can be made, nonetheless, for using criteria based on SES rather than income for evaluations of this kind (*11*). SES-based at-risk status can be determined for all children born in a State, and therefore a coverage rate can be calculated; similar determinations are not possible using income criteria. Additionally, for the purpose of evaluation, these risk criteria may also be less susceptible to the reporting bias that may occur with the income-based enrollment criteria used by the WIC Program (*1,2*). We do not wish to imply, however, that program enrollment should be based on the at-risk criteria used for this evaluation.

We wish to emphasize that coverage and targeting rates should be examined in a relative rather than absolute sense among the small geographic units. As shown in the Tennessee example, when comparing coverage and targeting rates across the State, areas with relatively lower rates can be detected, and they can be regarded as potential areas where function of the program can be improved. Further, a single value—either coverage rate or targeting rate—should not be used to assess how a program functions in a specific area or a State without comparing it with other areas or States.

The procedure we used to link program data with vital birth records was based on the matching of common identifiers on both files. The relative ease of data linkage for evaluation of other programs is a function of the availability and accuracy of names and dates of birth on the program file. In this Tennessee WIC example, the computer matching procedure achieved a relatively high matching rate (89 percent) with few duplicate matches and without having to resort to the laborious hand matching of records. The linked program and birth records can also be used for evaluations of health outcomes. For example, potentially it can be used to assess the health outcomes related to participation in the program as demonstrated by the birth outcome assessment of the prenatal WIC program of Missouri (*6,9*).

This evaluation of the Tennessee pediatric WIC Program could potentially be applied to other

maternal and child health-oriented programs if program records can be linked to the birth records. For health outcome, evaluations, or the development of guidelines for the distribution of funds, this procedure could be performed periodically. With coverage and targeting information available to them, WIC Program managers from State and local levels will have additional tools to guide their program decisions on a continuing basis.

References

1. U.S. General Accounting Office: Report to the Secretary of Agriculture: need to foster optimal use of resources in the Special Supplemental Food Program for Women, Infants, and Children (WIC). GAO/RCED 85-105. U.S. Government Printing Office, Washington, DC, 1985.
2. Food and Nutrition Service, U.S. Department of Agriculture: Special Supplemental Food Program for Women, Infants, and Children. Rules. Federal Register 42: 43205, Aug. 26, 1977. U.S. Government Printing Office, Washington, DC.
3. Centers for Disease Control: Nutrition surveillance 1983. DHHS Publication No. (CDC) 85-8295, Atlanta, GA, August 1985.
4. Institute of Medicine: Preventing low birth weight. National Academy Press, Washington, DC, 1985.
5. Egbuonu, L., and Starfield, B.: Child health and social status. Pediatrics 69: 550-557 (1982).
6. Stockbauer, J. W.: WIC prenatal participation and its relation to pregnancy outcomes in Missouri: a second look. Am J Public Health 86: 61-67 (1986).
7. Rush, D.: National WIC evaluation. An evaluation of the Special Supplemental Food Program for Women, Infants, and Children. Five vols. U.S. Department of Agriculture, Washington, DC, 1986.
8. Diehr, P.: Small area statistics: large statistical problems. Am J Public Health 74: 313-314 (1984).
9. Schramm, W. F.: WIC prenatal participation and its relationship to newborn medicaid costs in Missouri: a cost/benefit analysis. Am J Public Health 75: 851-857 (1985).
10. Rush, D.: Further evidence of the value of the WIC program. Am J Public Health 75: 828-829 (1985).
11. Payne, S. M. C., and Strobino, D. M.: Two methods of estimating the targeting population for public maternity services programs. Am J Public Health 74: 164-166 (1984).

Adults' Accounts of Onset of Regular Smoking: Influences of School, Work, and Other Settings

DAVID HILL, PhD
RON BORLAND, PhD

The authors are with the Centre for Behavioural Research in Cancer, Anti-Cancer Council of Victoria, Australia. Dr. Hill is Director, and Dr. Borland is Senior Behavioural Scientist.

Tearsheet requests to Dr. Hill, Director, Centre for Behavioural Research in Cancer, Anti-Cancer Council of Victoria, 1 Rathdowne St., Carlton South, Victoria 3053, Australia.

Synopsis

A representative population sample of 546 adults in Victoria, Australia, who had ever smoked were asked to describe the general setting where they first took up regular smoking and who, if anyone, influenced them to begin. Although school was the dominant setting (35 percent), particularly for younger respondents 20–34 years (55 percent), the workplace was also an important setting for uptake of regular smoking. Overall, 34 percent reported taking up smoking while in a job.

The probability of taking up smoking at work increased with age but, even among younger respondents, many did not begin smoking until they started work. Fourteen percent took it up between leaving school and commencing college or a university or their first job, and 22 percent of those who attended college or a university took up smoking in that setting.

One-quarter of the sample said that nobody had influenced them to take up smoking, but most of the remainder indicated that either friends, family, or workmates had played a part. Most mentioned were good friends at school (20 percent), good friends known socially (14 percent), and good friends at work (7 percent). Others listed were family (7 percent), boy friend or girl friend (7 percent), and "other people" at school (5 percent), or at work (5 percent), or known socially (5 percent). Overall, 10 percent had taken up regular smoking under the influence of workmates at work, suggesting that smoke-free workplace policies might be useful in the long term in reducing the prevalence of smoking in the community.